Aust. Wildl. Res., 1982, **9**, 365–71

Numbers and Distribution of Kangaroos in the Queensland Pastoral Zone

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Abstract

Kangaroos were censused in the pastoral zone of Queensland (537 000 km^2) and in an area abutting it to its west (90 000 km^2) during the winter of 1980. Red kangaroos, *Macropus rufus*, occurred throughout the survey area but concentrated in its south-west, and also to the west of Winton. Eastern greys, *Macropus giganteus*, attained high or very high densities in the south-east of the survey area, with medium densities along its eastern margin. Numbers within the survey area were estimated as 1·8 million red kangaroos and 3·0 million grey kangaroos, at overall densities of 2·8 and 4·7 km^{-2} respectively. Densities within the pastoral zone were not grossly in excess of those outside it, in contrast to the position in some of the other states. Extrapolation of mapped density isoclines suggests that these two species of kangaroos in Queensland as a whole number about 2·3 million red kangaroos and 5 million grey kangaroos. The legal Queensland kangaroo harvest in 1980 took about 10% of the total population of each species.

Introduction

The Queensland Pastoral Zone is here defined as the land within the Queensland wild-dog barrier fence (Fig. 1), an area of 537 000 km^2. It is used predominantly for extensive sheep grazing. Red kangaroos and grey kangaroos were censused in the southern half of the zone in early May 1980, and in the northern half, and in an area between its western boundary and the South Australian border, in late August 1980. Kirkpatrick (1967) mapped the range of the grey kangaroo throughout Queensland, and Kirkpatrick and McDougall (1971) that of the red kangaroo. Although Poole's (1975, 1977) maps suggest that only the eastern grey kangaroo, *Macropus giganteus*, is found in Queensland, there is now evidence (Caughley, unpublished) that the western grey, *Macropus fuliginosus*, also extends into southern Queensland. However, its density there is likely to be so low, relative to that of the eastern grey, that for purposes of this study it can be considered a negligible component of the fauna. With little loss of realism, therefore, we can declare all grey kangaroos seen by us as *M. giganteus*.

Large contrasts in kangaroo density have been observed between the inside and outside of the New South Wales pastoral zone (Jarman and Denny 1976; Caughley *et al.* 1980) and the South Australian pastoral zone (Grigg, unpublished). In late April 1979 we ran a number of transects across the Queensland barrier fence to check for a similar effect farther north.

Methods

All transects were flown at 76 m (250 ft) above ground at a speed of 185 km h^{-1} (100 knots). Two observers, one on each side of a Cessna 182, each scanned a 200-m strip in his or her side of the aircraft. Previous surveys had shown that all the observers for these surveys return counts within a few per cent of each other, and so there was no need to adjust counts to standardize observers. The counts of all observers were multiplied by these visibility correction factors (Caughley *et al.* 1976): 2·29 over open

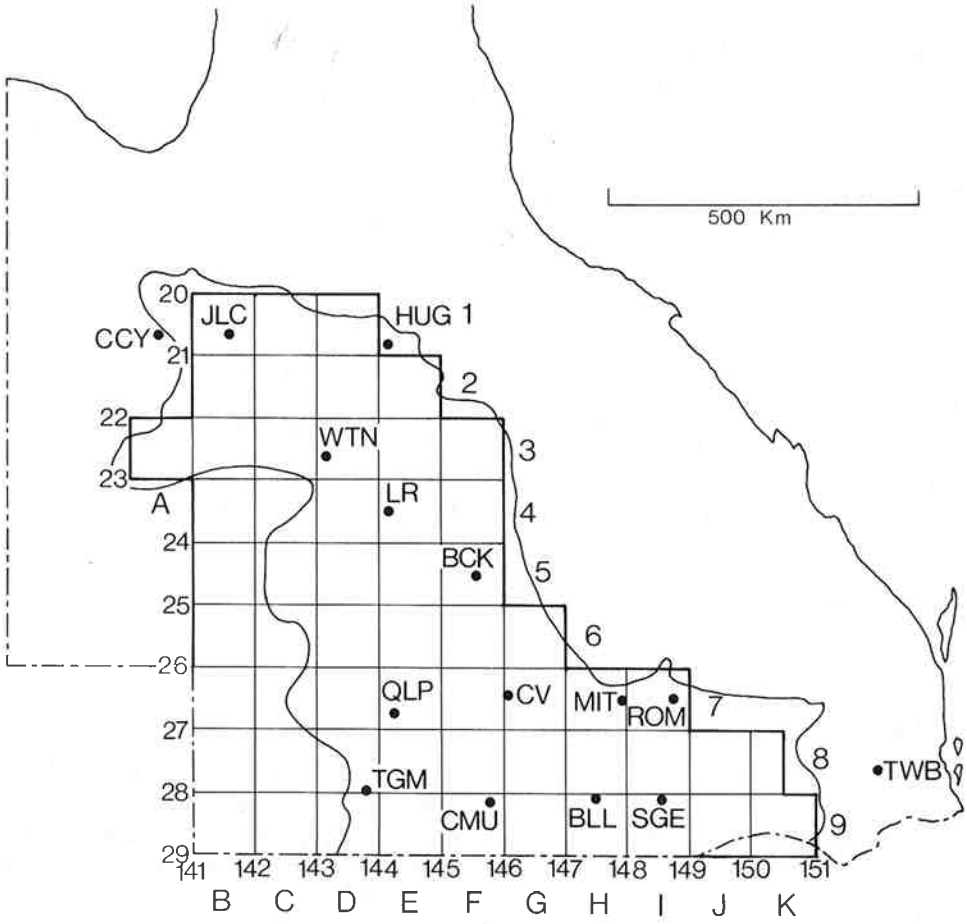

Fig. 1. The degree blocks within which numbers were estimated, and the Queensland barrier fence. Towns are coded by their aeronautical abbreviations: BCK, Blackall; BLL, Bollon; CV, Charleville; CCY, Cloncurry; CMU, Cunnamulla; HUG, Hughenden; JLC, Julia Creek; LR, Longreach; MIT, Mitchell; QLP, Quilpie; SGE, St George; TGM, Thargomindah; TWB, Toowoomba; ROM, Roma; WTN, Winton.

country, 2·36 over light cover, 2·43 over medium cover and 2·57 over dense cover. The details of the survey methods have been reported elsewhere (Caughley *et al.* 1980; Caughley and Grigg 1981) as have been the methods of analysis (Caughley 1977).

Scanning survey of the pastoral zone. The pastoral zone was divided into blocks of 1° latitude by 1° longitude (Fig. 1) and surveyed by a standard sweep of east–west transects spaced at intervals of 55·5 km (i.e. $\frac{1}{2}$ degree of latitude = 30 nautical miles) along latitudes $X°\,15'$ and $X°\,45'$, where X is each degree between 20°S. and 28°S. Densities and numbers of kangaroos were calculated for each degree block.

Scanning survey west of the pastoral zone. Most of the area bounded by latitudes 23°S. and 29°S. and longitudes 141°E. and 143°E. lies outside the pastoral zone. The more eastern column of degree blocks in this area was sampled by two north–south transects along 142°15′E. and 142°45′E. The western column

of blocks was surveyed by a single transect along 141°30′E. Pseudo-replication was achieved by splitting this transect into a northern and southern half within each degree block.

Survey across the barrier fence. The Queensland barrier fence forms a 4600-km loop, anchored on the New South Wales border near Thargomindah on the west and Goondiwindi in the east, and extending to a little beyond Cloncurry and Hughenden in the north (Fig. 1). The western limb was sampled by 15 subequally spaced transects crossing the fence at right angles between the New South Wales border and the latitude of Longreach. Thirty kilometres of each transect lay within the pastoral zone and 30 km outside it. Thus the two halves of each transect were paired in all respects other than their positions relative to the fence. The northern limb of the fence was traversed similarly between Julia Creek and Hughenden (10 transects), the eastern limb north-east of Charleville (five transects).

Table 1. Estimated densities and numbers of red kangaroos by degree blocks
Values are means ± standard errors. See Fig. 1 for block code

Degree block	Density (km^{-2})	Estimated numbers	Degree block	Density (km^{-2})	Estimated numbers
1B	4·08 ± 1·65	47 200 ± 19 100	7B	0·05 ± 0·05	600 ± 600
1C	1·09 ± 0·54	12 600 ± 6000	7C	2·79 ± 1·21	30 800 ± 13 300
1D	4·70 ± 1·64	54 300 ± 18 900	7D	3·61 ± 2·35	39 900 ± 26 000
2B	5·04 ± 3·45	57 900 ± 39 600	7E	1·42 ± 1·08	15 700 ± 11 900
2C	2·68 ± 0·16	30 800 ± 1800	7F	2·17 ± 2·02	23 900 ± 22 300
2D	3·53 ± 1·83	40 500 ± 21 100	7G	0·10 ± 0·10	1000 ± 1000
2E	1·97 ± 1·52	22 700 ± 17 500	7H	0·36 ± 0·36	4000 ± 4000
3A	8·50 ± 5·69	97 000 ± 64 900	7I	0·17 ± 0·17	1800 ± 1800
3B	14·54 ± 3·53	165 900 ± 40 200	8B	0	0
3C	7·33 ± 3·34	83 600 ± 38 100	8C	2·00 ± 0·16	21 900 ± 1700
3D	4·32 ± 0·34	49 200 ± 3900	8D	5·00 ± 2·82	54 800 ± 30 900
3E	4·03 ± 2·23	45 900 ± 25 400	8E	0·61 ± 0·28	6700 ± 3000
3F	1·08 ± 0·76	12 300 ± 8700	8F	1·35 ± 1·20	14 800 ± 13 200
4B	6·32 ± 1·59	71 500 ± 18 000	8G	0·76 ± 0·24	8400 ± 2600
4C	3·75 ± 2·03	42 500 ± 23 000	8H	0·64 ± 0·64	7000 ± 7000
4D	2·82 ± 0·63	31 900 ± 7100	8I	0·57 ± 0·24	6200 ± 2600
4E	2·59 ± 0·91	29 300 ± 10 200	8J	0	0
4F	0·74 ± 0·42	8300 ± 4800	8K[A]	0	0
5B	4·58 ± 1·35	51 500 ± 15 100	9B	5·08 ± 1·65	55 100 ± 17 900
5C	5·30 ± 0·41	59 600 ± 4600	9C	0·67 ± 0·54	7300 ± 5800
5D	3·50 ± 2·02	39 300 ± 22 700	9D	10·81 ± 6·53	117 200 ± 70 800
5E	4·36 ± 1·61	48 900 ± 18 100	9E	2·10 ± 0·07	22 800 ± 800
5F	2·65 ± 1·64	29 700 ± 18 400	9F	2·23 ± 1·81	24 900 ± 19 700
6B	0·66 ± 0·11	7300 ± 1300	9G	1·58 ± 0·17	17 200 ± 1800
6C	1·03 ± 0·66	11 400 ± 7300	9H	1·21 ± 0·26	13 100 ± 2900
6D	3·57 ± 1·20	39 800 ± 13 400	9I	1·04 ± 0·98	11 300 ± 10 700
6E	2·13 ± 0·84	23 700 ± 9400	9J	0·13 ± 0·13	1400 ± 1400
6F	2·57 ± 1·56	28 600 ± 17 400	9K	0·54 ± 0·54	5900 ± 5800
6G	0·40 ± 0·26	4500 ± 2900			
			Total	2·80 ± 0·24	1 761 400 ± 151 100

[A] Only western half surveyed.

Results

Scanning Survey

In all, $56\frac{1}{2}$ degree blocks were covered by the standard sweep of 629 695 km^2. We calculate that this area contained 1 761 000 ± 151 000 (estimate ± standard error) red kangaroos at an overall density of 2·80 ± 0·24 km^{-2} (Table 1), and 2 966 000 ± 210 000 eastern grey kangaroos at 4·71 ± 0·33 km^{-2} (Table 2).

The average density estimates alone are of limited biological interest because they include land beyond the effective distribution boundary of both species. More revealing is the density pattern mapped at a resolution of one degree. Density estimates listed for each degree block in Tables 1 and 2 are contoured in Figs 2 and 3.

Table 2. Estimated densities and numbers of grey kangaroos by degree blocks
Values are means ± standard errors. See Fig. 1 for block code

Degree block	Density (km^{-2})	Estimated numbers	Degree block	Density (km^{-2})	Estimated numbers
1B	0·30 ± 0·17	3500 ± 2000	7B	0	0
1C	1·24 ± 1·05	14 300 ± 12 100	7C	0·07 ± 0·07	700 ± 700
1D	1·12 ± 1·11	12 900 ± 12 800	7D	0·07 ± 0·07	800 ± 800
2B	0	0	7E	0·88 ± 0·73	9700 ± 8100
2C	0·24 ± 0·24	2700 ± 2700	7F	2·64 ± 0·86	29 200 ± 9500
2D	0·70 ± 0·46	8000 ± 5300	7G	8·43 ± 1·62	93 200 ± 17 900
2E	6·87 ± 3·35	78 900 ± 38 500	7H	10·53 ± 1·88	116 300 ± 20 800
3A	0	0	7I	16·78 ± 3·88	185 400 ± 42 800
3B	0·03 ± 0·03	300 ± 300	8B	0	0
3C	0·09 ± 0·04	1100 ± 400	8C	0	0
3D	0·43 ± 0·12	5000 ± 1300	8D	0·26 ± 0·07	2900 ± 800
3E	5·36 ± 1·32	61 100 ± 15 100	8E	0·88 ± 0·60	9600 ± 6500
3F	12·33 ± 0·54	140 700 ± 6100	8F	4·50 ± 1·25	49 300 ± 13 600
4B	0	0	8G	22·79 ± 8·37	249 600 ± 91 700
4C	0·07 ± 0·07	700 ± 700	8H	17·18 ± 2·12	188 100 ± 23 200
4D	0·43 ± 0·07	4900 ± 700	8I	28·11 ± 7·78	307 800 ± 85 100
4E	1·43 ± 0·80	16 200 ± 9100	8J	14·86 ± 9·08	162 700 ± 99 400
4F	2·53 ± 0·16	28 600 ± 1800	8K[A]	6·41 ± 0·87	35 100 ± 4800
5B	0	0	9B	0	0
5C	0	0	9C	0	0
5D	0·42 ± 0·03	4700 ± 300	9D	0·24 ± 0·18	2600 ± 1900
5E	5·26 ± 2·26	59 200 ± 25 400	9E	0·78 ± 0·03	8400 ± 300
5F	9·75 ± 0·98	109 600 ± 11 100	9F	2·90 ± 0·68	31 500 ± 7400
6B	0	0	9G	20·11 ± 1·08	218 200 ± 11 700
6C	0	0	9H	21·08 ± 4·67	228 800 ± 50 700
6D	0·26 ± 0·26	2900 ± 2900	9I	16·97 ± 8·02	184 100 ± 87 000
6E	0·50 ± 0·49	5600 ± 5500	9J	13·57 ± 3·00	147 200 ± 32 600
6F	5·68 ± 1·53	63 300 ± 17 100	9K	4·97 ± 0·77	53 900 ± 8400
6G	2·40 ± 1·18	26 800 ± 13 100			
			Total	4·71 ± 0·33	2 966 100 ± 209 700

[A] Only western half surveyed.

Fence Survey

Along the western limb of the barrier fence, kangaroos were on average 1·7 times more abundant on the halves of the transects within the pastoral zone than on the corresponding halves outside it. The difference was highly significant by two-factor analysis of variance. The surveys across the northern and eastern limbs of the fence detected no significant difference between inside and outside the fence.

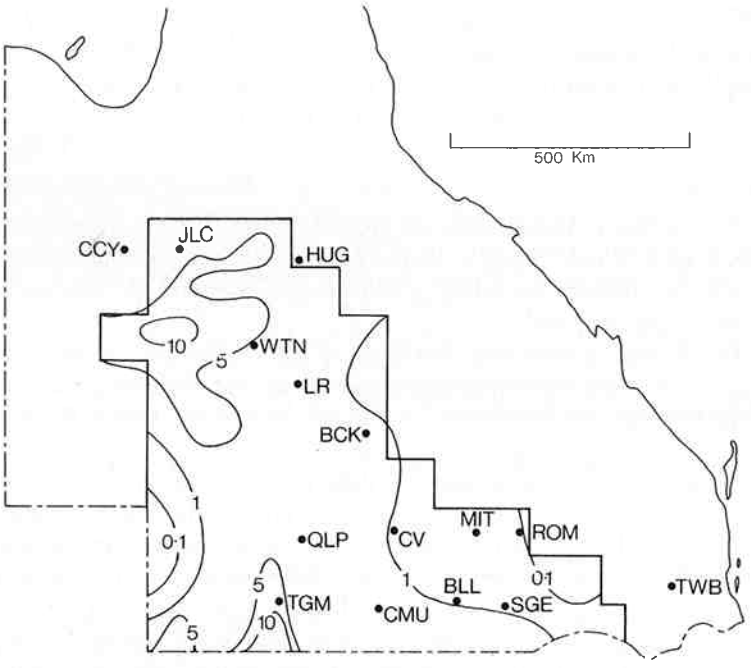

Fig. 2. Densities of red kangaroos. Towns are coded as in Fig. 1.

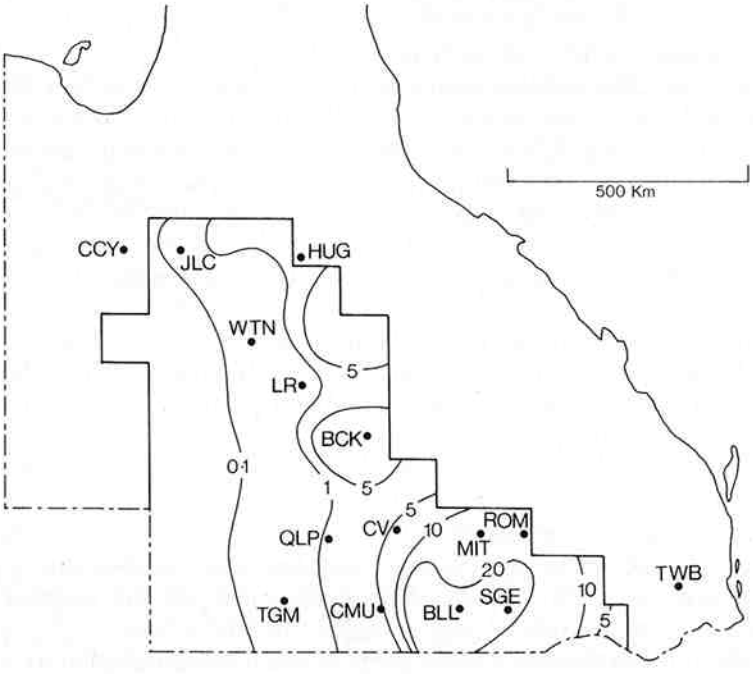

Fig. 3. Density of grey kangaroos. Towns are coded as in Fig. 1.

Discussion

The following arbitrary definitions rate density estimated as an average over a degree block (*c.* 11 000 km^2): 'high', > 10 km^{-2}; 'medium', 5–10; 'low', 1–5; 'very low', < 1. The 'effective boundary' of a species' distribution is the 0·1 km^{-2} isocline.

Red Kangaroos

Fig. 2 shows that red kangaroos occupy all the pastoral zone except a relatively small area in its south-east corner. To the west of the pastoral zone there is a second area beyond the effective boundary of the species' distribution, coinciding with the edge of the Simpson Desert.

Medium and high densities are restricted to the south-west and north-west of the survey area. The south-western concentration is the tip of a crescent of high density that swings through north-western New South Wales (Caughley *et al.* 1977) into South Australia (Caughley and Grigg 1981).

The second concentration is south of Julia Creek and west of Winton, its centre being at about 23°S.,141°E. The 5 km^{-2} isocline of this concentration remains open to the west in Fig. 2, but reconnaissance flown subsequently reveals that it closes well short of the Northern Territory border. Extrapolation of contours, guided by reconnaissance data, suggests the survey reported here censused about 80% of the red kangaroos in Queensland. The state therefore holds about 2·3 million red kangaroos. In 1980, 223 000 reds were harvested legally in Queensland (data from Queensland National Parks and Wildlife Service), suggesting a rate of legal harvest of about 10% of the total population.

Grey Kangaroos

The dominant feature of grey kangaroo dispersion (Fig. 3) is a region of very high density (>20 km^{-2}) centred on Bollon, halfway across the south of the state. It is bordered by zones of high and medium density, the contours of which remain open to the north-east. This concentration of density extends deep into New South Wales along the land watered and drained by the Barwon, Bokhara, Culgoa, Castlereagh, Macquarie and Bogan Rivers, and then loops around the southern edge of the Cobar Peneplain. It was mapped in that state by Caughley *et al.* (1977). Densities have risen considerably there (Caughley *et al.* 1979) since the 1975 base year of that map. Subsequent aerial surveys by the New South Wales National Parks and Wildlife Service provide more recent information on density. The 147–148°E. column of degree blocks, which runs through the Bollon concentration of Queensland, returned densities of grey kangaroos in New South Wales of 18 km^{-2} between 29° and 30°S. in 1979 (the state border is at 29°S.), 22 km^{-2} between 30° and 31°S. in 1980, and 24 km^{-2} between 31° and 32°S. in 1980 (Judith Caughley, personal communication).

Although the isoclines of Fig. 3 show that the region of very high density in Queensland almost certainly lies entirely within the survey area, the areas of high and medium density are truncated at its eastern boundary. Naive extrapolation of these latter isoclines, with one eye on a land-use map, suggests that a further 2 million should be added to the 3 million estimated for the pastoral zone, to approximate the population of grey kangaroos in Queensland.

If 5 million is accepted as a crude approximation for Queensland as a whole, it allows an equally crude estimate of the harvesting rate. A legal harvest of 597 000

grey kangaroos was taken in Queensland during 1980 (data from Queensland National Parks and Wildlife Service), suggesting a legal offtake of about 12% of the population.

Acknowledgments

We thank the Queensland National Parks and Wildlife Service for use of their data on legal offtakes, the New South Wales National Parks and Wildlife Service for use of their data on recent aerial surveys in that state, and P. Harlow, L. Smith, J. Short and G. Ross for observing.

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